REMARKS

Claims 29-58 are pending in the application. Support for the amendment of claims 29, 54, 57 is found in the specification at page 37, lines 11-25 of WO 04/033079. Claim 40 was amended to correct format. Claim 46 was amended to make it definite. Claim 58 was amended to correct an erroneous dependency. No new matter has been introduced. Acceptance is respectfully requested.

Claim Objections

Claim 40 was objected to based on 1) improper format, and 2) duplication of compounds listed as monomers. Both the format and the list of compounds have been corrected as required.

35 U.S.C. § 112 Rejections

Claims 29-58 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter applicant regards as the invention.

a. Specifically, claims 29, 54 and 57 were rejected because they contain the term "treating" which was viewed by the examiner as indefinite. As a consequence, dependent claims 30-53, 55-56, and 58 were also rejected as indefinite.

Although the term "treating" is clearly defined in the specification on page 37, lines 11-25, Applicants have amended independent claims 29, 54 and 57 to replace the term "treating" with "partially hydrolyzing the polyphosphoric acid moieties". The specification provides a large number of different conditions for partial hydrolysis of the polyphosphoric acid moieties. For example, suitable conditions are described on page 37, line 11 through page 38, line 32. As such, it is submitted that the phrase "partially hydrolyzing the polyphosphoric acid moieties" is clear and definite.

b. Claims 29, 54, and 57 were deemed indefinite because the precursors made in step A) and/or step B) could be used in step C). In response to this rejection, claims 29, 54, and 57 have been amended to include the word "optionally" before the heating process outlined in step B). Since step B is optional, step C) is definite when it refers to products from either step A)

or step B) (i.e., using either the basic monomer solution in step A) or the heated polymer solution of step B)).

c. Claim 46 was deemed indefinite because the word "derivatives" was not explicitly defined. In response, the claim has been amended to replace the word "derivatives" with the word "salts", which has a clear definition.

d. Claim 57 was deemed indefinite because the preamble (lines 2-3 of the claim) recites a membrane-electrode unit including a membrane and electrode, and later recites the steps of coating the electrode with the membrane. The claim language has been amended so that the preamble explicitly states that the steps listed in the claim detail the process by which the electrode is coated with the membrane.

35 U.S.C. § 102 Rejections

Claims 29-34, 36, 41-43, 47-50, and 52-58 have been rejected under § 102(b) as being anticipated by US Patent Publication 2004/0062969 (Sakaguchi et al.). The Examiner states that Sakaguchi teaches a path for synthesizing a polybenzazole compound having a phosphono group used as an electrolyte film for a fuel cell.

Applicants respectfully disagree with the Examiner's interpretation of the present invention. Step D) – treatment of the membrane until it is self-supporting through the partial hydrolysis of the polyphosphoric acid moieties – is neither explicitly, nor inherently encompassed by the Sakaguchi reference. Moreover, Applicant's claimed invention is the proton conductive membrane itself – not merely the process of formation of the polymer, or the polymer made up of the specified monomers alone.

The membrane formation process claimed in the present Application is distinct from that described in the Sakaguchi reference based at least on step D). In the Sakaguchi reference, formation of the membrane requires first polymer formation, and then precipitation of the polymer by pouring it into water. The precipitated polymer is then repeatedly rinsed. (See Examples 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 on pages 21 to 26 of the Sakaguchi application). As a result of the precipitation and neutralization of the polymer, it is clear that the polyphosphoric acid in Sakaguchi is removed before partial hydrolysis can occur. As such, it is evident that the polyphosphoric acid is not present in a partially hydrolyzed form in the

membrane disclosed by Sakaguchi. In contrast, Applicants' membrane comprises partially hydrolyzed polyphosphoric acid moieties.

Additionally, Applicants' resulting membrane has distinct, highly advantageous properties over Sakaguchi and other prior art membranes for fuel cells. After treatment in step D), the membrane typically contains only about 5% b.w. polyzole polymer and 95% b.w. acid – even when "dry" the membrane is composed of more than 90% b.w. of liquids. This internal concentration of liquids that allows the Applicant's membrane to have superior conductivity at temperatures over 100°C. (See specification page 8, lines 4-8). The behavior of this membrane is similar to that of a super absorber with a gel-like, rubberish texture. The treatment step D) results in a membrane that has an interpenetrating network (IPN) internal structure. (See specification page 37, lines 16-28). Such material can not be obtained by simply dissolving the polymer taught by Sakaguchi and casting a film. The films that result from casting the Sakaguchi polymer are rigid, stiff polymers that have distinct properties (physical, mechanical, and conductive) from the present invention. See specification, page 7 line 9 to page 8 line 8.

Additionally, the membranes claimed in the present invention are designed for use in high temperature fuel cells. The claimed invention provides membranes that have proton conductivity at high temperatures, e.g. 160°C, without humidification. In contrast, the membranes taught by the Sakaguchi application show proton conductivity only with humidification, e.g. at RH 95%. Such humidification can only be done at low temperature, e.g. at 80°C. The Sakaguchi membranes can not function at or near the temperature range of the claimed membranes – hence the materials are distinct.

It is clear from a thorough comparison of the membrane formation process, and the mechanical and conductive properties of the resultant membranes, that the present invention is novel and non-obvious from that claimed in the Sakaguchi reference.

As to the Examiner's comments relating to claims 30-34, 36, 41-43, 47-50, 52-53, 55-56, and 58 – the rejections all depend on the assumption that Sakaguchi's membrane and the Applicants' claimed membranes are equivalent because the monomers employed in polymer production are similar. However, as discussed above, the membrane claimed in the present application and the mechanical and conductive properties of that membrane are distinct from that disclosed in the Sakaguchi patent. Since the independent claims, 29, 54, and 57 are not

anticipated by the Sakaguchi reference, as discussed above, dependent claims 30-34, 36, 41-43, 47-50, 52-53, 55-56, and 58 are therefore not anticipated.

35 U.S.C. § 103 Rejections

Claim 35 was rejected as obvious in light of Sakaguchi in view of the Matsuoka publication (US 2001/0003130). Claims 39, 40, 44, and 45 were rejected under § 103(a) based on Sakaguchi in light of Gerber (US patent 3,783,137). Claim 51 was rejected under § 103(a) as being obvious in view of Sakaguchi combined with Kerres (US 6,767,585). The Applicants' respectfully disagree with the Examiner's conclusions.

Matsuoka discloses the use of 1,2,4,5-tetraaminobenzene to make a polybenzazole polymer. The Gerber patent teaches polymers made with tetracarboxylic acid anhydride monomers (relating to claim 39), polybenzimidazole-type compositions (relating to claim 40), and diacid halides (relating to claims 44 and 45). Kerres teaches cross-linked polymers.

The rejected claims, 35, 39, 40, 44, 45 and 51 all depend on claim 29. Claim 29 requires that the polymer formed in steps A through C have partially hydrolyzed polyphosphoric acid moieties and thus making the membrane self-supporting (step D). None of the references teach, suggest or motivate the partial hydrolysis of the phosphoric acid moieties. In fact, the Sakaguchi application teaches away from partial hydrolysis by teaching neutralization of the polymer before membrane formation.

Moreover, as noted in the section of the response dealing with the rejection under 35 USC § 102, in view of Sakaguchi, the claimed polymer membrane has a number of advantages compared with the polymer membranes of prior art. For example, the Applicants' membrane can be used at temperatures from <80°C to over 200°C without loss of efficiency or a sacrifice in membrane life. Additionally, Applicants' membranes are cheaper and easier to produce than previously known in the prior art. No where in Sakaguchi, Matsuoka, Gerber, or Kerres is it suggested that these advantages would be achieved by requiring partially hydrolyzed polyphosphoric acid moieties in the membrane. Therefore, the Sakaguchi reference in light of Matsuoka, Gerber or Kerres does not teach, suggest or motivate a person skilled in the art to make the claimed membrane by the partial hydrolysis of the polyphosphoric acid moieties in the

polyazole polymer to result in a self-supporting, gel-like membrane to be used in high temperature applications.

Furthermore, Kerres' cross-linked polymers utilized in Sakaguchi's brittle, low temperature, humidity-dependent membrane will not result in a membrane comparable to the Applicants' claimed invention. The differences between the Sakaguchi membrane and the present invention – with Sakaguchi's requiring humidity to function, having no conductivity of the membrane above 100°C (the boiling point of water), and having distinct processes of formation – can not be overcome merely by the introduction of a cross-linked polymer that is disclosed in Kerres' patent.

The present invention is non-obvious in light of Sakaguchi in combination with Matsuoka, Gerber, and/or Kerres. Sakaguchi explicitly teaches away from a membrane with partially hydrolyzed polyphosphoric acid moieties. Moreover, there is no suggestion, teaching or motivation in any of the four cited references to partially hydrolyze the polyphosphoric acid moieties of the polymer to get a membrane with the enhanced physical and conductive properties as the Applicants' claimed invention.

Double Patenting Rejections

Claims 29-58 have been provisionally rejected based on non-statutory double patenting over claims 26-52 of co-pending Application 10/529,993 in view of the Sakaguchi reference. Applicants respectfully postpone responding to this provisional rejection until such time that it is indicated that some subject matter is allowable.

0/530,002

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims (29-58) are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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